Anonymous Referee #1

page 1 line 26: “The stability of the mound gas fluxes over diurnal and annual scales coincides with the constant nature of the nest internal gas and thermal environment that guarantees continuously favorable conditions for the fungal symbiont.”

This is saying that mound fluxes are stable, but contradicts line 22 where it is stated that there can be quite large (~30-60% increase/decrease) in seasonal flux. I’d rephrase one or the other to keep the message consistent – is the main finding that fluxes are highly variable or not?

Thank you for pointing out this inconsistency. Our point here was that although there seem to be some variance in fluxes taking place for example between different seasons, this variance is smaller than what has been reported from mounds of other termite species that do not cultivate fungi. For example, some wood-feeding termites in Australia showed 90% decrease in CO2 flux from wet to dry season (see reference Jamali et al. 2013 in the manuscript), which is clearly more than observed in our study. We agree than in current form in the abstract this message is not clear and thus we have removed this sentence.

page 2 line 2: can define methane and carbon dioxide abbreviations here

Corrected

page 13 line 2: add space after period in ‘5).However, ‘

Corrected

page 17 line 7: is this a small intra-annual difference in flux? I wouldn’t necessarily see a 64 % decrease at the grassland and 35 % increase at the bushland as ‘small’ – see comment from abstract as well. Perhaps think of rephrasing this finding – it seems that season certainly plays a role, and also has differential effects depending on the species.

In the following few sentences you discuss why intra-annual variation could exist – I’d frame the finding as the fluxes do indeed vary, and this could be due to the following factors you discuss from line 9 – 24.

Thank you. We have removed the sentence stating that these changes are small. Now the discussion is focused on the factors that might cause intra-annual variation.

page 18 line 6 – A bit late to mention this, but for mounds that started off in bad shape and then were deemed dead on the second measurement, are these worth including in the study at all? They don’t seem to represent fully functioning termite mounds, which is what most of the discussion throughout the paper lies around. What do we gain from including mounds that were incomparable across seasons, or partially functioning from the start?

We prefer to keep this point in the discussion. It is an important factor to take into account in the sampling of the fungus-growing termite mounds. For instance, longer term studies have to take possible mound death into account in the sampling. It’s also not easy to tell from outside (without excavation or mound flux or internal concentration measurements) whether a termite colony is active or has died recently. In future studies it would be useful to have a simple method, based for

example on CO_2 concentration measurements, to assess the aliveness of the termite colony before measuring fluxes. Not knowing the active/dead mound status makes it difficult to understand the factors affecting mound fluxes and may lead to wrong conclusions.

page 19 line 3: I'd be careful interpreting the spike in flux at midnight – it's one mound and one measurement, so not a lot of data to go off of there.

Thank you. We have removed the discussion regarding the spike in the midnight due to the limited data.

page 19 line 15: "supports the interpretation" is a bit awkward phrasing, maybe it's more of a hypothesis rather than interpretation?

Changed to "hypothesis".

page 19 for section 4.3: any CO2 fluxes coming from the soil are not restricted to termite derived: could also be from microbial activity. Therefore, I think it's more useful to consider how CH4 changes in soil going further from the mound, as that's the real indicator of termite activity. CH4 values were near zero or negative, so I'd reduce the argument that this finding supports termites having a broad soil network where gas exchange is being significantly impacted.

Both, the soil CH_4 and CO_2 fluxes were always higher close to the mound (at 2 m distance from the mound perimeter) compared to further distances (4 to 6 m from the mound perimeter) (Fig. 7). This result was clear and differed from the earlier measurements in soil feeding termites in Amazon which had enhanced soil fluxes around the mound only up to 0.5 m from the perimeter of the mound (van Asperen et al., 2021). We have discussed how the size and structure of mounds built by fungus-growing termites compared to those of soil feeding termites could potentially explain these differences. It is also well-documented that *Macrotermes* mounds in Kenyan grasslands are typically surrounded by extensive tunnel networks (Darlington 1982). We believe that such tunnels increase soil porosity and could partially explain the enhanced soil gas fluxes in mound immediate vicinity. Instead, the last paragraph related to potential differences in foraging tunnels in grasslands and bushlands is largely speculative as we have no data that could support these interpretations. We decided to delete this last paragraph.

For further study, it could be interesting to compare methane flux across diurnal cycles for soil/mound fluxes - to see if you can support or describe when termites are out foraging based on when methane is being picked up in greater concentration from the soils. Not sure if it would be a very clean way to answer that question, but just an idea!

Thank you. This is a good suggestion for a future study.

Anonymous Referee #2

The authors have improved the parts indicated, and the manuscript looks good. I have only three mini suggestions to improve the manuscript:

P3, line 27: during dry and rainy seasons-→ during a period in the dry and the wet season.

Corrected

P 10, line 6-9: add units between brackets for all variables, so also for P, A, dC/dt

Corrected

P 25, line 19, CH4 is not in subscript

Corrected